California Actions for a Sustainabl Transportation Future

University of California, California State University, Califor a Community Colleges Sustainability Conference

McKinley Addy, P.E.

August 2, 2008

California Energy Commission

ANNOUNCEMENT

The UC Project Management Institute is a Registered Provider with The American Institute of Architects Continuing Education Systems. Credit earned on completion of this program will be reported to CES Records for AIA members. Certificates of Completion for non-AIA members are available upon request (emily.montan@ucop.edu).

This program is registered with the AIA-CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product. Questions related to specific materials, methods and services will be addressed at the conclusion of this presentation.

Outline

- Energy Commission Overview
- Challenges for a Sustainable Transportation Future
- Actions for a Sustainable Transportation Future
- Implications for the California State University, University of California and California Community College System

Some Take Away Messages

- California has made a decision to move toward a sustainable transportation (energy) future.
- That future embraces multiple low-carbon and cleaner transportation fuels.
- Four key policy actions embody California's transition to a sustainable transportation (energy) future:
  - The State Alternative Fuels Plan (AB 1007)
  - The California Global Warming Solutions Act of (AB 32)
  - California's Low Carbon Fuel Standard
  - The Alternative and Renewable Fuels and Vehicle Technology Funding Program (AB 118)

Key Questions

- What are the agencies thinking about sustainability and a sustainable transportation future for California?
- What is the role of the California Energy Commission? What is the California Air Resources Board's role?
- How does the UC-CSU-CCC view of sustainability fit the State's policy framework?
- What might the new sustainability policies and actions of the state mean for California Community Colleges, California State University and University of California systems in general and campuses in particular?

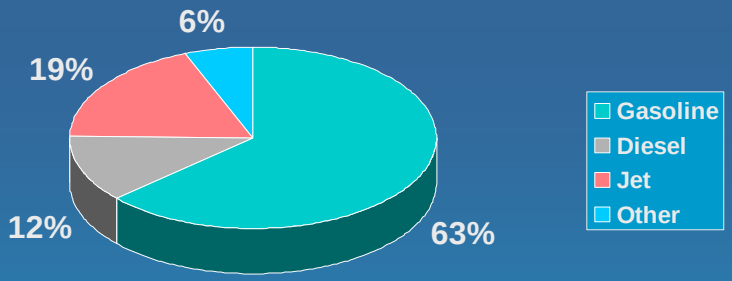
Energy Commission Overview

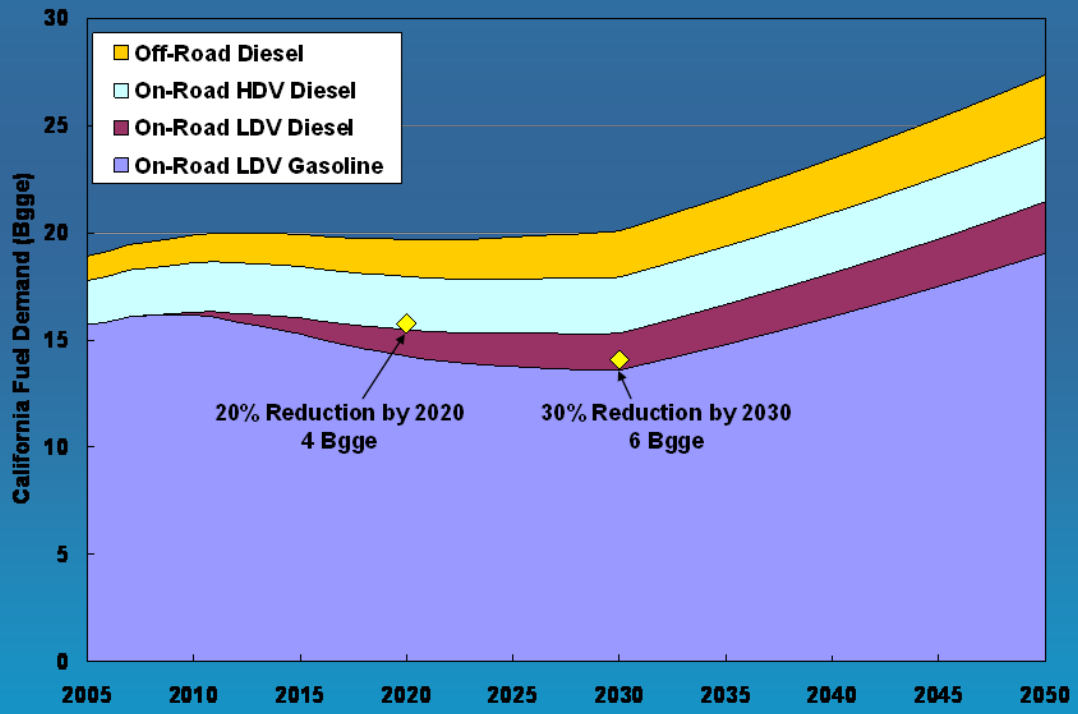
- California's principal energy policy making agency
- Prepares biennial Integrated Energy Policy Reports
- Licenses power plants > 50 megawatts
- Sets efficiency standards for buildings and appliances
- Performs demand and price forecasts for transportation fuels, natural gas and electricity
- Conducts research, development, demonstration and deployment of advanced energy technologies for the transport and power sectors

Sustainable Transportation Future - Challenges

Petroleum Reduction and California

Transportation Petroleum Use in California- 2006

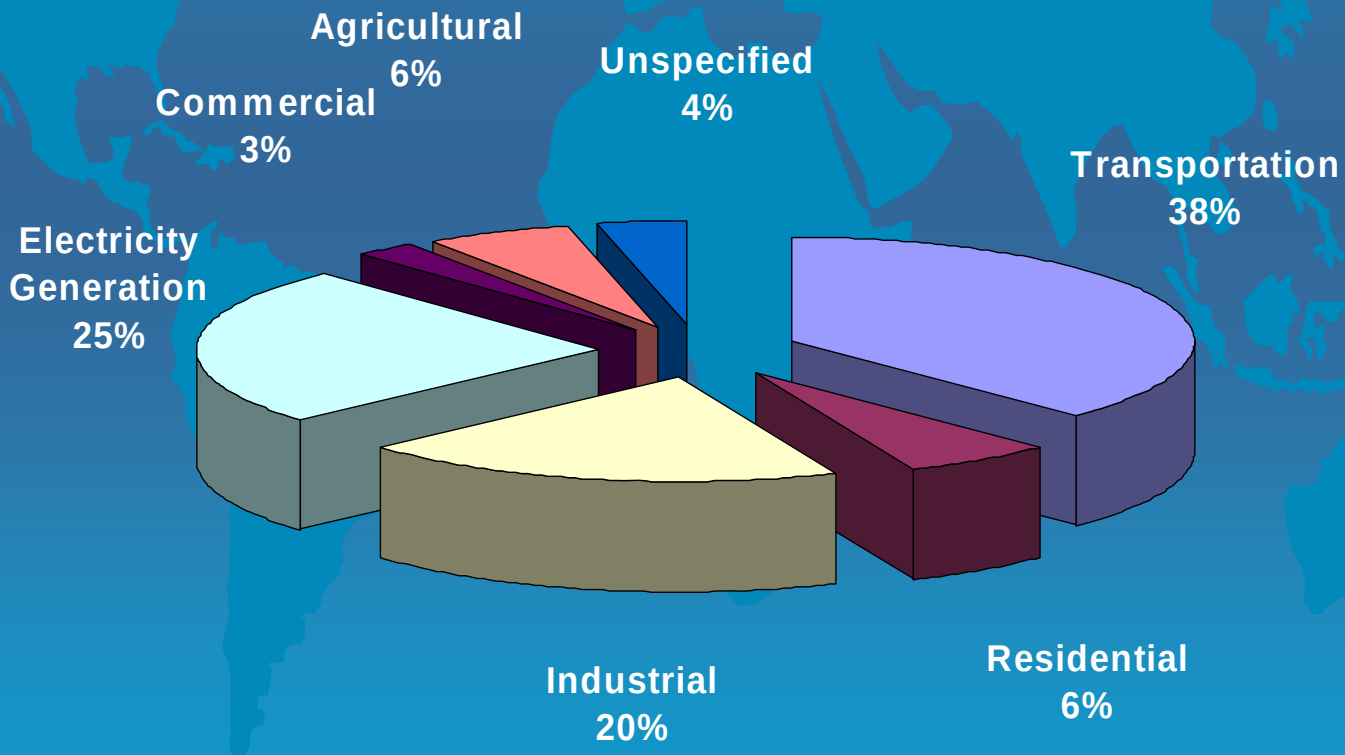




Sources: CEC, ARB, TIAX

Sustainable Transportation Future - Challenges

Transportation is the Largest Source of GHG Emissions



Source: California ARB GHG Emissions Inventory, November 19, 2007

Sustainable Transportation Future - Challenges

Land Impacts

- Consumptive land use for fuel production (tar sands, agricultural land)
- Land conversion for fuel production (fauna, flora, tundra effects)
- Land cover effects (forest to palm plantation)
- Land pollution from exploration and production (spills, hazardous contaminants)

Sustainable Transportation Future - Challenges

Water Impacts

- Consumptive water use for petroleum and non-petroleum fuel production
- Water pollution from fuel production (i.e. nitrogen, phosphorus, toxic, organic carbons, metals runoff)
- Waste water discharge
- Water pollution from fuel use (spills)

96% of corn used for ethanol production is not irrigated
785 gallons water per gallon of ethanol (average crop irrigation)
3-4 gallons water per gallon ethanol (dry grind production)
1.9-6 gallons water per gallon ethanol (conceptual cellulosic production)
2-2.5 gallons water per gallon gasoline (petroleum refining)
0.6 gallons water per kilowatt-hour (coal-fired power plant)

Source: September/October 2007 • Southwest Hydrology • **23**

Sustainable Transportation Future - Challenges

Costs

- **Annual True Cost of Petroleum Dependence [1] Billions of US Dollars**

	Low Est.	High Est.
Federal tax breaks and subsidies [2]	$65	$113
Health-care costs	$54.7	$672.3
Crop losses	$3	$6
Damage to materials and buildings	$1	$8
Damage to forests	$0.2	$2
Water pollution	$0.4	$1.5
Total of all states' subsidies	$4.1	$4.1
TOTAL	$128.4	$806.9

1. Annual Costs to U.S. Consumers of Oil and Auto Industry Subsidies and Externalities (in billions of U.S. dollars), "Lives Per Gallon: The True Costs of Our Oil Addiction", Terry Tamminen, p 62
2. 2 Ibid, p 60

Sustainable Transportation Future - Challenges

Costs

- Other Cost Considerations
  - Volatility premium (est. 10% of prevailing price) [3]
  - Supply disruption premium (est. as high as $2/gallon) [4]
  - GHG premium (est. 22 to 80 cents per gallon) [5]
  - Wealth Transfer (est. $1.60 to $4 per gallon)[6]
  - Current Costs (est. $0.40 to $1.20 per gallon)[7]
- True Cost Est*.: $9 to $17/gallon

3. Lives Per Gallon: the True Cost of Our Oil Addiction, Terry Tamminen, p 73

4. Reducing California's Petroleum Dependence, Joint Agency Report, California Energy Commission, P600-03-005F, August 2003

5. Based on EU September 2007 Carbon Credit Prices and $85/ton avoided CO2 damage prices (Mechanical Engineering, April 2007)

6. The Hidden Cost of Oil: An Update, Milton R. Copulos, National Defense Council Foundation, January 2007; ORNL

7. Ibid

* Includes the prevailing price of gasoline or diesel.

Sustainable Transportation Future – Challenge: What is sustainability?

AB 118 Treatment of Sustainability

- AB 118 Sustainability Provisions *Section 44271(a)(2)*
- "Establish sustainability goals to ensure that alternative and renewable fuel and vehicle deployment projects, on a full fuel cycle basis, will not adversely impact the state's natural resources, especially state and federal lands."

Source: California Health and Safety Code

Sustainable Transportation Future – Challenge: What is sustainability?

AB 118 Treatment of Sustainability

- Recognition there are sustainability concerns with alternative fuels, especially biofuels
- California market size creates risk of induced environmental & social damage from large volumes of new transportation fuels
- No off-the-shelf sustainability model or program
- Sustainability complex and evolving

Sustainable Transportation Future – Challenge: What is sustainability?

AB 118 Treatment of Sustainability

- Sustainability means “lower impact” not “zero impact”
- Sustainability encompasses global environmental and social issues and cannot be limited to “state’s natural resources”
- Sustainability goals and measures will require environmental performance and production practices that exceed extant regulatory standards
- Infrastructure cannot be separated from fuel pathway

Actions for California's Sustainable Transportation Energy Future

- AB 2076 – Report on Reducing Petroleum Dependence
- AB 1007 – State Plan to Increase Alternative Fuels
- AB 1493 – Regulates CA vehicle CO2 tail pipe emissions
- ZEV Mandate
- AB 32 – Caps CA CO2 emissions in 2020
- SB 1368 (Sets limits on power plant CO2 emissions)
- Executive Order S-03-05 – Caps CA CO2 emissions in 2050 to 80% below 1990 levels
- Low Carbon Fuel Standard (EO 3-01-07) – reduces fuel carbon intensity by 10 percent in 2020
- AB 118 funds alternative fuels and infrastructure at $118 million/yr available for 8 years

Actions: AB 1007 Legislative and Policy Context

- Petroleum Reduction Goals —AB 2076 Report in 2001 —2003
  - – Reduce On Road Gasoline and Diesel Demand by 15% Below 2003 levels by 2020
  - – Increase Use of Non Non-Petroleum Fuels To 20% of On Road Fuel Consumption by 2020 and 30% by 2030
  - - Goals reaffirmed in Transportation IEPR Recommendations – 2003 and 2005

- Alternative Fuels Plan —AB 1007, Statutes of 2005
  - – Develop a Plan to Increase the Use of Alternative Fuels in 2012, 2017 and 2022

- Bioenergy Action Plan —Governor's Executive Order in 2006
  - – Increase In In-State Production of Biofuels to 20% by 2010, 40% by 2020 and 75% by 2050

AB 1007 Plan Requirements

- Develop Plan to Increase Alternative Fuel Use in California
- Evaluate Fuel Options on a Full Fuel Cycle Basis (GHGs, Criteria Pollutants, Toxics, Multi-Media Environmental Impacts)
  - No Net Material Increase in Air Pollution, Water Pollution and No Damage to Human health
- Establish Goals (Vehicles/Fuel Consumption) To Increase Alternative Fuels In 2012, 2017 and 2022
- Optimize Environmental and Public Health Benefits
- Minimize Economic Costs to the State
- Maximize Economic Benefits of Producing Alternative Fuels in California
- Consider Issues Consumer Acceptance and Costs
- Identify Methods to Overcome Barriers to Alternative Fuel Use
- Recommend Policies to Ensure Alternative Fuel Goals are Attained
  - Standards
  - Financial Incentives (Vehicles, Fuel Supply, Fueling Stations)
  - Programs (R&D and other Activities)

AB 1007 Plan Conclusions

- No Single Policy Action Can Help Achieve Multiple Goals
- Moderate Growth Of Alternative Fuels Can Achieve
  - AB 2076 Petroleum Reduction Goals
  - Instate Bio-energy Action Plan Goals
  - Partial GHG Emission Reduction Targets
- All Alternative Fuels Are Needed
- Plausible Mix Includes Contingency Examples

AB 1007 Plan Conclusions Contd.

- State Incentives of $100 Million Per Year Needed for 15 Years
- Market Investment of at Least $100 Billion Required Between 2007-2050
- New industry and market participants needed
- Alternative Fuel Mix Cost Effective as Early as 2015 or In 2030 to 2050 Timeframe

AB 1007 Plan Driver Examples

Market Drivers	Market Barriers	Barrier Resolution
•Oil supply constraints •High crude oil prices •Resource nationalism •Renewed interest in alternative fuels •Competitive fuel supply •Alt fuel price advantage •Policy Initiatives •-AB 1007 •-AB 32 •-LCFS, SIP •-New Fed. initiatives	•Product availability •Persistent but changing vehicle incremental cost •On-board storage technology •On-board storage cost •Limited fueling network •Consumer acceptance •Lack of consumer awareness	•Expand product offerings •Stabilize thru consumer-oriented pricing •Long-term, consistent support to deploy ANG •Develop new materials; achieve scale economies •Implement long-term growth plan, including support for HRAs •Consumer education •Marketing and promotion by auto companies, fuel suppliers, NPOs, government

AB 1007 Plan Elements

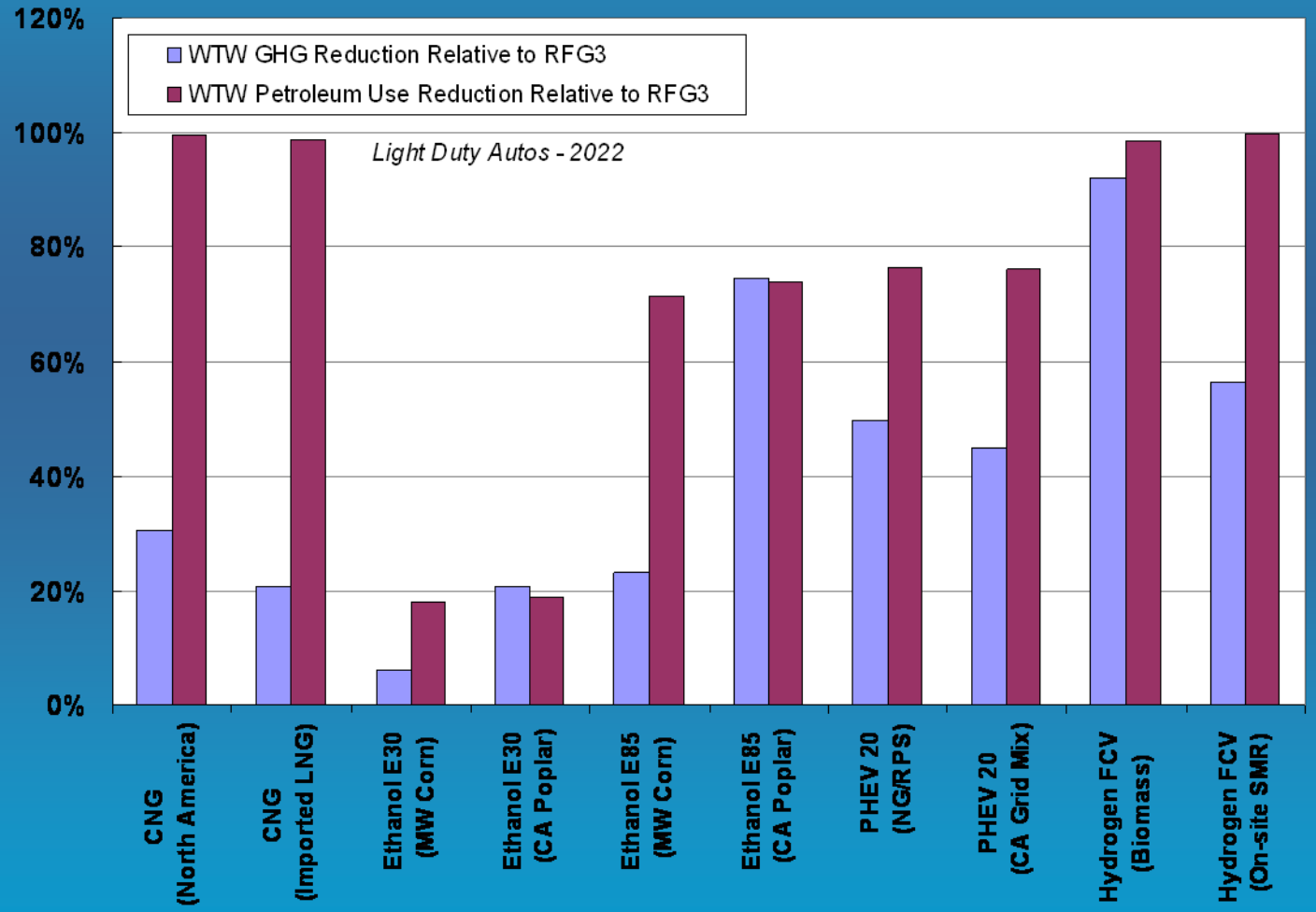
- Full Fuel Cycle Analysis
- Plan Fuel Use Results
- Plan Portfolio Examples
- Plan Economic Findings
- Plan Recommendations

AB 1007 Full Fuel Cycle Analysis

- Completed Full Fuel Cycle Report and Companion Reports required under the legislation
- Modified GREET Model for California Conditions
- Quantified Environmental Footprint of 94 Fuel Pathways
- Used to Develop Low Carbon Fuel Standard Analysis
- Advanced “State of the Art” Methodology
- Established Transparent Process to Update Analysis
- Adopted by the Energy Commission June 2007

AB 1007 Full Fuel Cycle Analysis

Vehicle Petroleum and GHG Performance of Alternative Fuels for Light-duty Vehicles as a Function of Feedstock

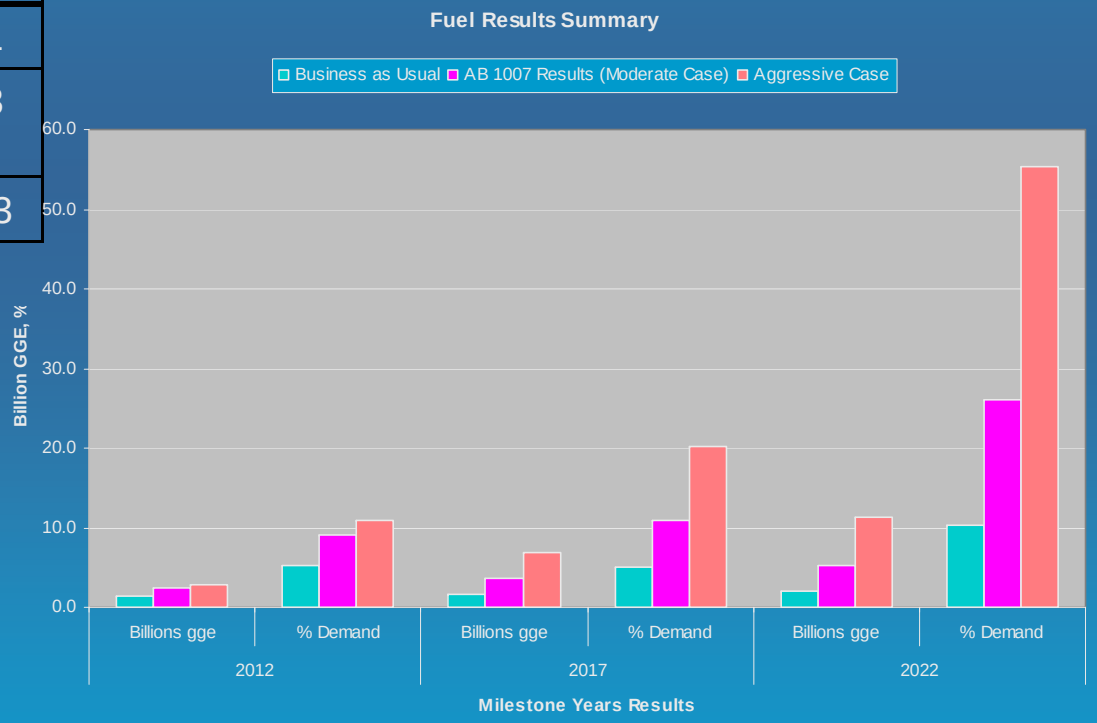


Source: TIAX LLC –CEC AB 1007 Full Fuel Cycle Analysis

AB 1007 Fuel Use Results

Maximum Feasible Alternative Fuel Use Results by Fuel (Summary for All Cases), Billions gge

Alternative Fuels Case	Milestone Year		
	2012	2017	2022
Business as Usual	1.4	1.7	2.1
AB 1007 Results (Moderate Case)	2.4	3.7	5.3
Aggressive Case	2.9	6.8	11.3



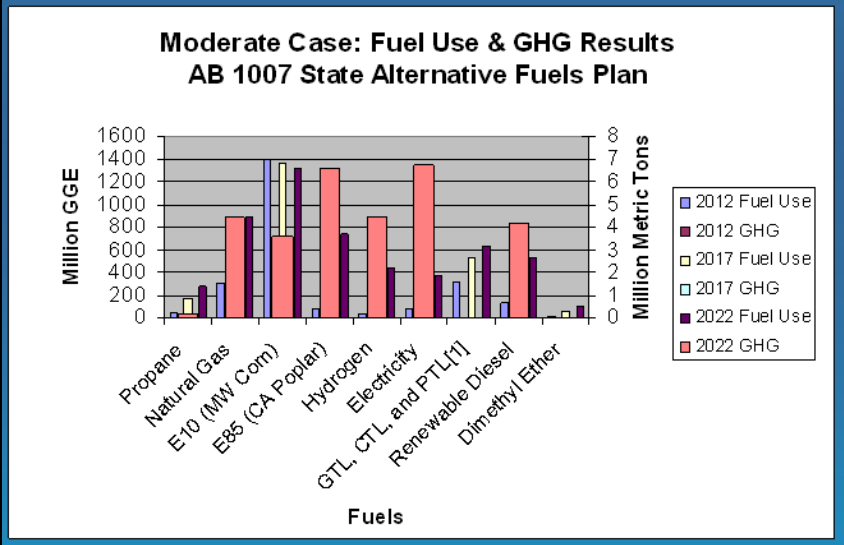
Source: California Energy Commission, Adopted AB 1007 State Alternative Fuels Plan, October 2007

AB 1007 Fuel Use Results

Maximum Feasible Alternative Fuel Use Results by Fuel (Moderate Case)

Mile Stone Year	2012		2017		2022	
	Fuel Use	GHG	Fuel Use	GHG	Fuel Use	GHG
Propane	48	<0.1	173	0.1	282	0.2
Natural Gas	306	1.5	518	2.5	885	4.4
E10 (MW Corn)	1394	3.8	1354	3.8	1327	3.6
E85 (CA Poplar)	83	0.7	434	3.9	738	6.6
Hydrogen	40	0.3	80	0.6	440	4.4
Electricity	86	2.1	187	5.1	376	6.7
GTL, CTL, and PTL[1]	320	0	530	0	630	0
Renewable Diesel	130	1	310	2.4	530	4.2
Dimethyl Ether	13	0	62	0	101	0
Total	**2420**	**10**	**3648**	**18**	**5309**	**30**

Fuel use measured in million gasoline gallon equivalent. For hydrogen and electricity, the petroleum displacement is greater than the fuel used due to the vehicle efficiency.
GHG on a full fuel cycle basis and in million metric tons per year.



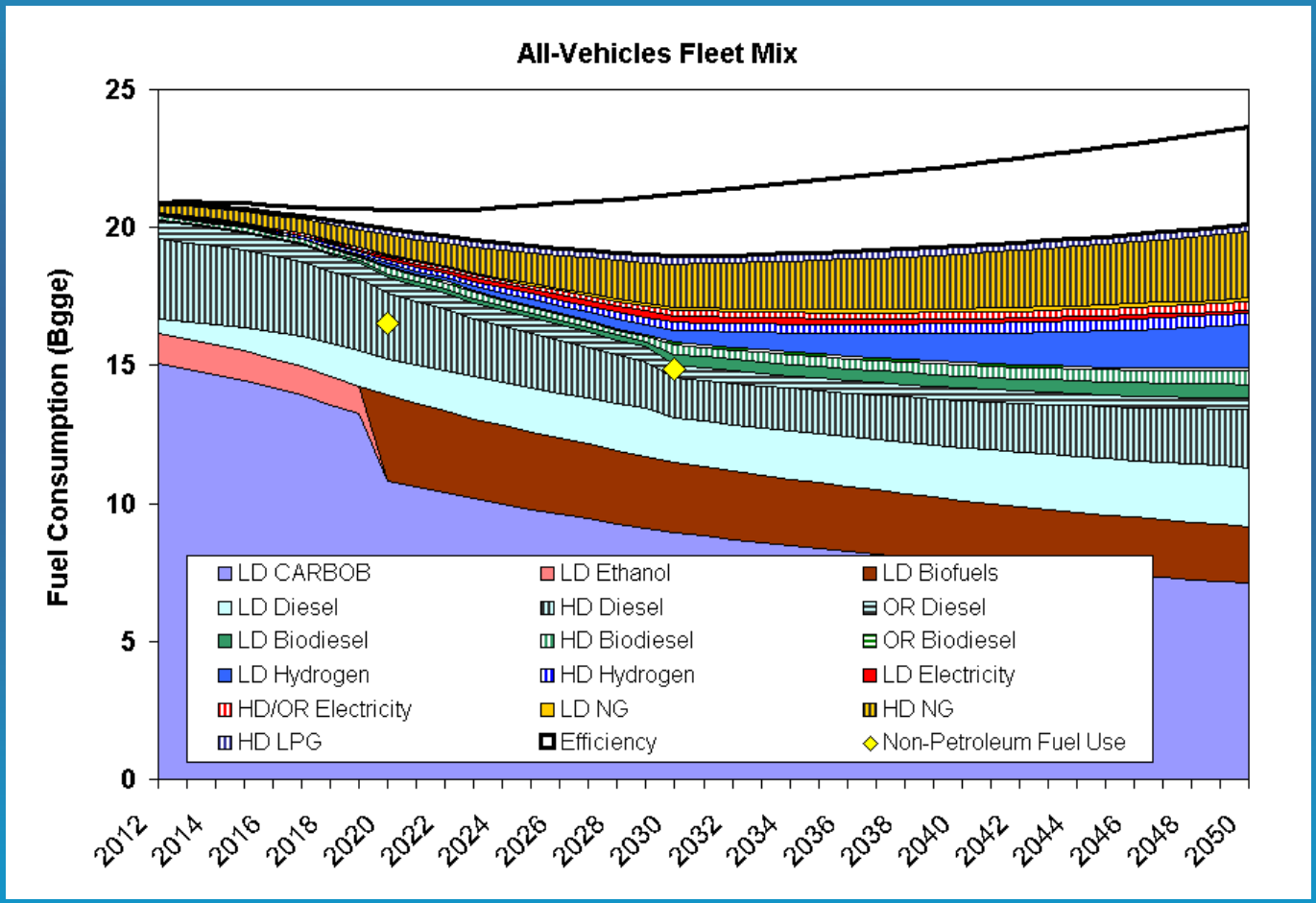
[1] PTL stands for petroleum coke-to-liquid fuel.

AB 1007 Example Fuel Portfolios

- Ethanol and Hydrogen
- Blends and Plug-in Hybrids
- Advanced Biofuels and Hybrids

AB 1007 Example Fuel Portfolios

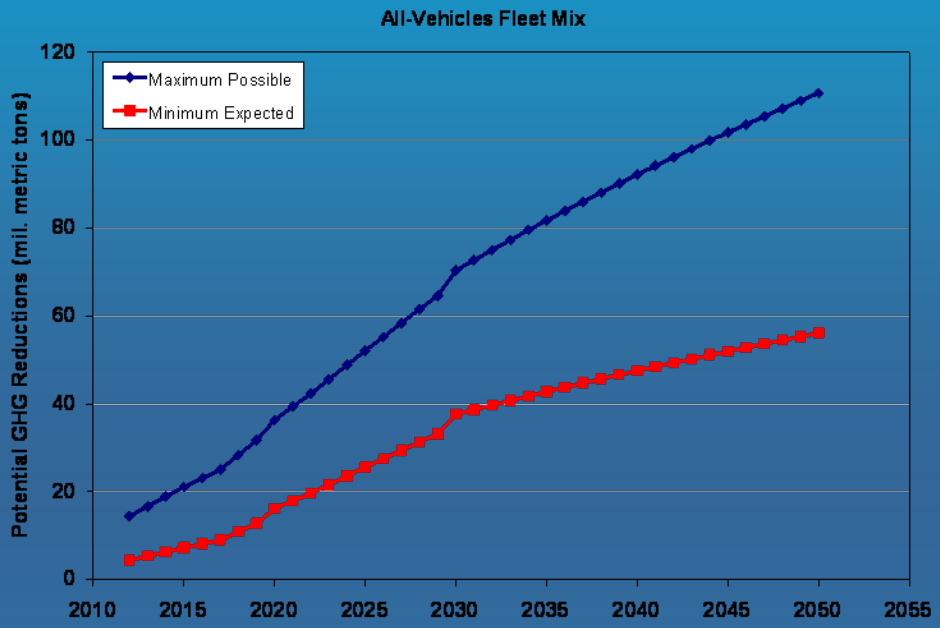
FUEL USE OUTCOMES – EXAMPLE FUEL MIX



Alt Fuels >50% of 2050 CA motor fuel demand by 2050.

Source: Energy Commission Adopted AB 1007 State Alt. Fuels Plan

AB 1007 Plan GHG, LCFS Outcomes



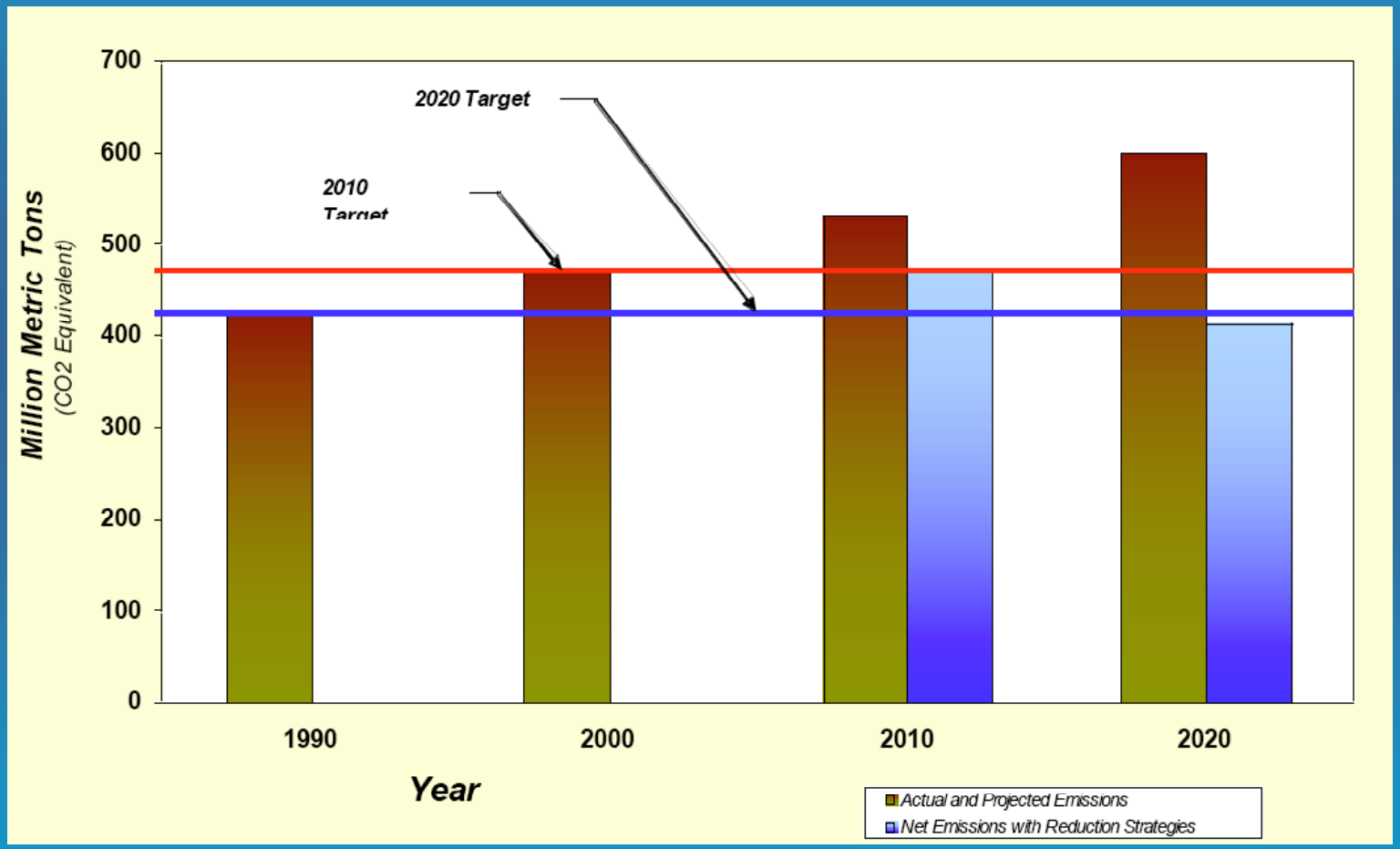
GHG and Low Carbon Fuels Standard Performance for Example 1 – Ethanol and Hydrogen Fuel Cell Electric Vehicles

Year	Petroleum Displacement (billions GGE)		GHG Reduction (MMT) *		LCFS (Percent Carbon Intensity)	
	Goal	Target	Goal	Target	Goal	Target
2012	---	1.8	---	4 – 14	---	1.1 – 5.3
2020	4	5.6	39	18 – 47	10	5.8 – 18.0
2030	6	8.7	---	37 – 68	---	10.6 – 22.5
2050	---	11.8	202	53 – 92	---	15.0 – 26.6

* GHG Reduction Targets are initial AB 32 and Governor's Executive Order targets, less Pavley GHG reduction estimates.

Actions: AB 32 GHG Reduction Goals

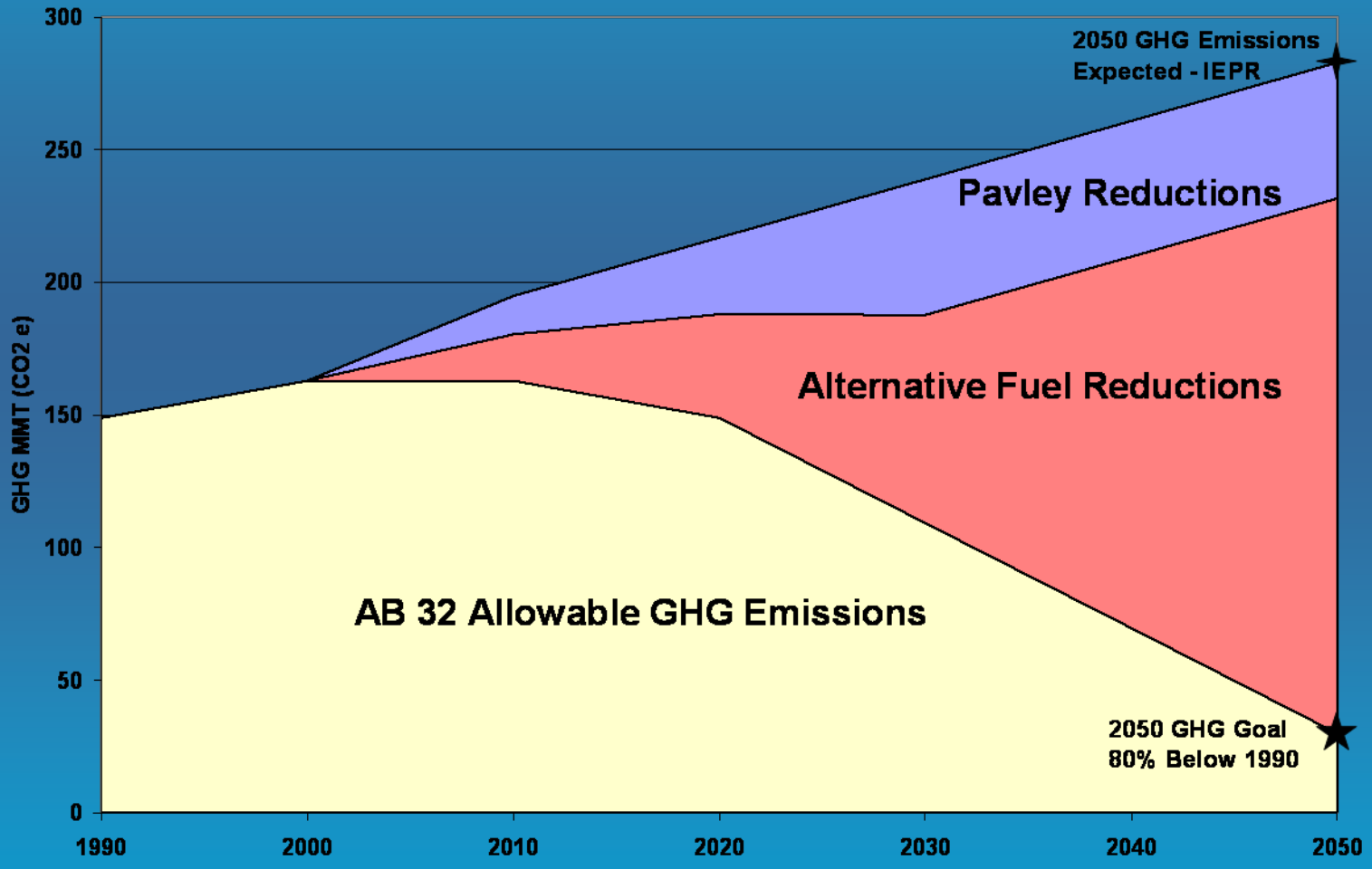
"…require the state board [CARB] to adopt a statewide greenhouse gas emissions limit equivalent to the statewide greenhouse gas emissions levels in 1990 to be achieved by 2020…"



---> 174 MMTCO2e/yr (29%) reduction over BAU by 2020 (CAT, 2006)

AB 32, Executive Order S-03-5 GHG Targets

Allocated fairshare GHG emissions from on and off road applications (excludes planes, trains, and ships)



Source: TIAX, For AB 1007 State Alternative Fuels Plan analysis

Measures to meet AB 32 Goals

- Group I Strategies – Discrete Early Action
- Group II Strategies – Additional Early Actions
- Group III Strategies – Later-term

Measures to meet AB 32 Goals

- Group I Strategies – Discrete Early Actions
  - Low Carbon Fuels Standard (EO S-01-07)
  - High GWP Refrigerant Restrictions
  - Landfill Methane Capture
- Enforceable by 2010
- 13 to 26 mm tone CO2 eq.

Source: Air Resources Board

Measures to meet AB 32 Goals

- Group III Strategies – Remaining Reductions
  - Scoping plan being developed
  - Scoping plan draft concept released
  - Some proposed measures
- ~111 mm tons CO2 eq by 2020.
  - **AB 1007 fuels?**

Source: Air Resources Board

Measures to meet AB 32 Goals

HD NGVs

AB 1007 fuels?

Alternative, Non-petroleum Low Carbon Fuels can reduce petroleum dependence and cost

6 %?

H2 FCV

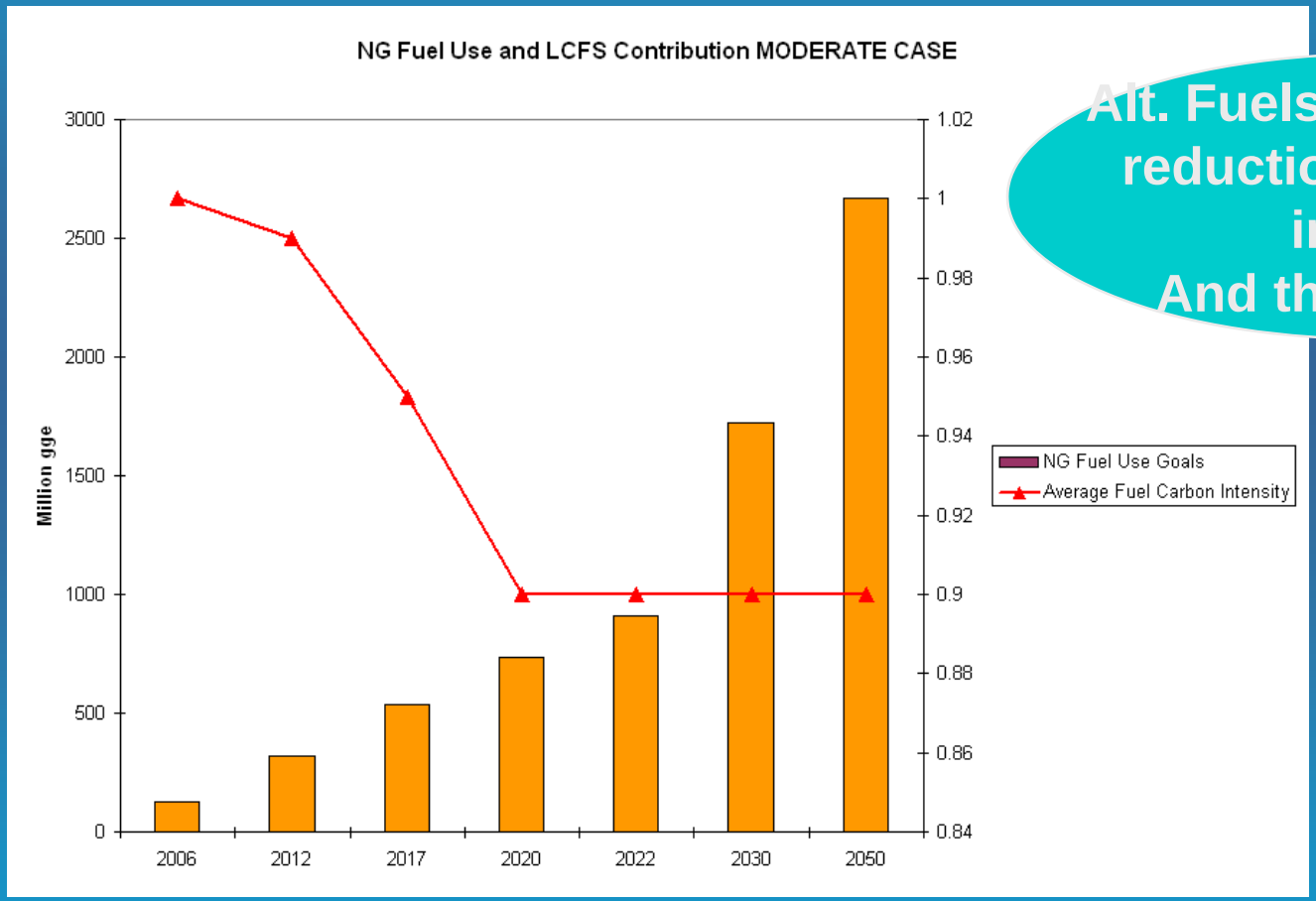
Honda GX

50 %?

2 %?

Actions: Low Carbon Fuel Std.

ESTIMATED LCFS NEXUS & IMPLICATIONS



Alt. Fuels contribute to reduction in AFCI of in 2020 And through 2050

Sources: California Energy Commission, University of California, Davis

AB 1007 Plan Economic Sustainability

- The Plan performed quantitative economic assessments:

  - ✓Capital Cost Assessment
  - ✓Consumer Payback Period
  - ✓Societal Cost-Effectiveness Analysis

AB 1007 Plan Economic Findings

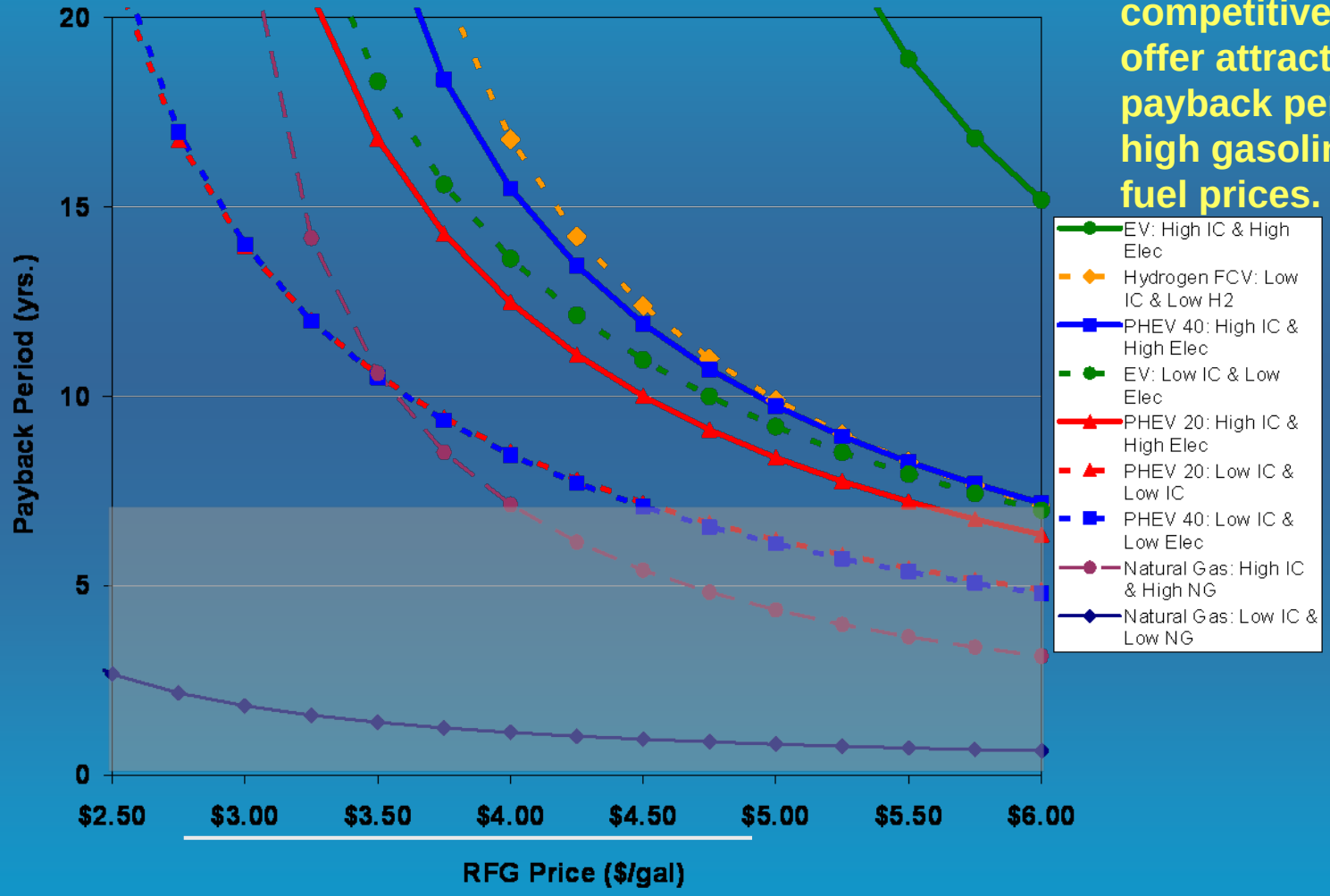
- Alternative fuels could produce savings for California consumers due to their overall lower cost, expanded choice and potential positive impact on petroleum fuel price volatility.

- Alternative Fuel Mix are Cost Effective as Early as 2015 or In 2030 to 2050 Timeframe.

- The increased use of alternative fuels under the Plan will result in a restructuring of California's transportation energy economy with revenue flows of about $19 billion from the petroleum sector to the agriculture, chemical industries and utility sectors by 2050.

AB 1007 Plan Economic Findings

AB 1007 alternative fuels are cost-competitive and offer attractive payback periods at high gasoline/diesel fuel prices.



[11] Assuming a discount rate of 8 percent, to approximate the rate of return on private investment.

AB 1007 Key Plan Recommendations

- Establish Goals to Increase Alternative Fuels: 9 % in 2012, 11% in 2017 and 26 % in 2022.

- California should work to extend federal incentives

- State should make available incentives and other forms of support of alternative fuels of $100 million per rear through 2022

Actions: AB 118 Alternative Fuel and Vehicle Technology Funding

- **Purpose**
  - –Transform California's transportation market into a diverse collection of alternative fuels and technologies and reduce California's dependence on petroleum.
- **Funding**
  - –For the *Alternative & Renewable Fuel and Vehicle Technology Program*, Energy Commission: $120 million/year for 7 ½ years.
  - –CARB: $80 million/year 7+ years for *Enhanced Fleet Modernization* and *Air Quality Improvement.*
- **Steps:**
  - ✓Plan, Annual Solicitations Implementing Regulations Investment
  - ✓Advisory Committee
  - ✓Establish Sustainability Working Group
- **Schedule:**
  - –Adopt Regulations and Investment Plan to Disburse Initial Funds about March 2009

Implications for CCC, CSU and UC Systems

- Campus Operations
  - Transportation Fuel and Electricity Procurement
  - Vehicle and Equipment Procurement
  - Campus-Industrial processes related activities
  - Campus-specific and systems-wide air, land, water and carbon foot-print assessments

Implications for CCC, CSU and UC Systems

- Curriculum and research programs impacts
  - New course offerings – low carbon technologies, sustainability research, low-carbon fuels research
  - New funding opportunities?
  - Design of new carbon emissions trading concepts?
- Lifestyle changes for students and faculty?
  - Travel behaviour
  - Transportation choices

QUESTIONS?

This concludes the American Institute of Architects Continuing Education Systems Program.

For more information about the presentation, Call CEC's Emerging Fuels and Technologies Office:

(916) 654-4634

or

Visit our Web site:

http://www.energy.ca.gov/ab1007/index.html

http://www.energy.ca.gov/altfuels/index.html

ACRONYMS

AB – Assembly Bill
AFCI – Average Fuel Carbon Intensity
ANG – Adsorbed Natural Gas (Tank)
ARB – Air Resources Board
BAU – Business-As-Usual
CA - California
CARB – California Air Resources Board
CAT – Climate Action Team
CEC – California Energy Commission
CO2 eq. – Carbon Dioxide Equivalent
CTL – Coal-To-Liquids
EV – Electric Vehicle
E30 – Gasoline with 30 percent ethanol content by volume
FCV – Fuel Cell Vehicle
GGE – Gallons Gasoline Equivalent
GHG – Greenhouse Gas Emissions
GTL – Gas-To-Liquid
HDV – Heavy-duty Vehicle
IC- Incremental Cost
IEPR – Integrated Energy Policy Report
LCFS – Low Carbon Fuel Standard
LD – Light Duty
LDV – Light-duty Vehicle
LNG – Liquefied Natural Gas
LPG – Liquefied Petroleum Gas
Mm – 'million metric'
MMT – Million Metric Ton
MW – Mid-west
NG – Natural Gas
NPO – Non-Profit Organization
PHEV – Plug-In Hybrid Electric Vehicle
PHEV 20 – PHEV with 20 mile all-electric range
PTL – Pet-Coke-To-Liquid
R&D – Research and Development
RFG 3 – California Reformulated Gasoline, Phase III
RPS – (California) Renewable Portfolio Standard
SIP – State Implementation Plan
SMR – Steam Methane Reforming
WTW – Well-To-Wheels